

**ECONOMIC GROWTH BEFORE AND AFTER REFORM:
THE CASE OF EGYPT**
KAMALY. Ahmed*

Abstract

This study analyzes the sources of growth in Egypt starting from the end of 1973 war until 2002. The study uses a new estimate for capital stock to estimate a skill-augmented aggregate production function for Egypt. Using growth accounting technique, the study decomposes growth into factor accumulation and productivity change. Results indicate that the relative importance of the sources of growth changes from one period to another. The eminent growth after the 1973 war was driven by high growth in capital accumulation and productivity. The poor performance in the 1980s could be attributed to the slowdown in capital growth as well as the dismal growth in productivity. This downward trend in capital growth continued even after the structural adjustment program in 1991 raising the contribution of labor in economic growth to a level close to the contribution of capital. Productivity, on the other hand, has shown signs for improvement starting from the second half of the 1990s.

JEL Classification: O47, E22, C22, C52

Keywords: Economic Growth, Egyptian economy, Growth Accounting, Total Factor Productivity.

1. Introduction and Motivation

Economists have always been infatuated with the process through which economies grow as well as providing answers to simple yet illusive questions such as why some economies grow faster than others? The importance of Solow's work (1957) is that it provides a tractable and elegant neoclassical framework to study economic growth. Based on this work, a vast theoretical as well as empirical literature dealing with economic growth and aspects related to it have

* Ahmed Kamaly, The American University in Cairo

emerged. For developing countries, understanding economic growth is of primary importance since growth is key for achieving sustainable development and reducing poverty.

As most developing countries, Egypt has a history of sporadic growth trend. Periods of boom and bust characterized the Egyptian economy for at least the last three decades. Moreover, the overall growth experience for the last thirty years has been disappointing especially relative to Egypt high population growth. What is indeed disturbing is that the economy has been stagnant since the 1980s. Even the recovery after the implementation of Economic Reform and Structural Adjustment Program (ERSAP) in 1991 was short-lived where the economy again reverted to another downward trend at the end of the 1990s that continued into the first years of the first decade of the second millennium.

This trend in economic growth as well as any other growth trend for that matter is just the result of factor accumulation and productivity change. Hence studying economic growth necessitates analyzing the sources of economic growth over time. The traditional methodology that is used for achieving this aim is known as growth accounting. Most of the studies using this technique are cross-country analyses that try to explore cross-country growth experience. Relatively few studies are individual country analysis, and only one study has analyzed the case of Egypt (Kheir-El-Din and Morsi, 2003).

This study differs from the study by Kheir-El-Din and Morsi (2003) in a number of important aspects. First, the data used in this study is more consistent. More precisely, this study makes use of a new consistent estimate for capital stock for Egypt. In addition, the figures for labor are obtained from one source without any interpolation or the use of more than one data series from multiple sources. Second, the study uses a more representative production function which includes explicitly a measure for labor skills. Fourth, the estimation of the production function does not impose constant returns to scale assumption. Fourth, the sample in this study covers the period 1974-2002 whereas the period used in the study by Kheir-

Kamaly,A. *Economic Growth Before and After Reform: The Case of Egypt*

El-Din and Morsi has a much earlier starting date, 1960 but the ending date was 1998.

The main objective of the paper is to analyze the trend in economic growth as well as the causes underlying this trend over the last three decades in Egypt and link it to economic policy, external and internal shocks and other factors that could influence output growth. This analysis of Egyptian growth experience necessitates estimating an economy wide production function and obtains the elasticities of labor and capital stock. Using the results of the regression analysis, one can calculate the contribution of capital stock, labor and total factor productivity (TFP) in economic growth. These different sources of growth together with the trend and pattern of factors accumulation are combined to give an objective account of the forces shaping output growth from the mid 1970s until the beginning of the 21st century.

The paper is organized as follows. Section two presents a brief account of the literature. Section three presents the sample and the methodology. Section four presents the obtained results. Section five discusses the sources of growth in the Egyptian economy and their trends over the last thirty years. Finally, section five concludes and gives some policy recommendations.

2. A Brief Exposition of the Literature

One of the many offspring of the work by Solow on economic growth is growth accounting. Even though not as vast as growth empirics; nevertheless, growth accounting literature has recently increased in size and gained popularity especially with the heated debate concerning the source of economic growth in East Asian countries which began by Young's study in 1995. What is interesting about this debate is the fact that it generates an interest among economists to gauge the sources of growth and compare them across regions to pinpoint the similarities and differences between the contributions of factor accumulation and productivity across regions.

Examples of such studies are Nehru and Dhareshwar (1994), Senhadji (2000), and more recently Han, Kalirajan and Singh (2004). The common denominator in all of these studies and other similar ones is the fact that they are cross-country analyses that combine country observations over a number of years. The strength of such studies lies in their ability to compare between regions across different time periods in terms of their sources of growth as well as to infer general observations on the disposition of growth. However, these studies are not appropriate to study individual countries. In fact, it is quite dangerous to extend the results of any cross-country analysis and apply them on any single country. From this point stems the importance of supplementing these cross-country studies with other more detailed country studies which focus on the experience of one country at a time, analyzing its growth path and studying the various factors affecting such path.

To carry on an exercise in growth accounting, all studies had to get estimates for the weights of factor inputs. Under the assumption of constant returns to scale (CRS), which is imposed by almost all studies, these weights are the same as the input shares in output; hence they can be obtained from national accounts data depending on the availability of data¹. In case of the unavailability of such national accounts data, these weights/elasticities could be readily estimated econometrically given data on factor inputs and output.

A number of studies, especially early ones, have used the national accounts data of a number of developed countries to come with the value of $1/3$ as the share of physical capital in output, then used this number as a benchmark value for capital share for all countries (Hall and Jones, 1999). This implicitly assumes that technology is identical across different countries whether developed or developing. Later, studies differentiated between countries in terms of income,

¹ Most of these studies assume a Cobb-Douglas production function for its tractability and its good fit. It is worth noting that the estimated weights together with TFP are sensitive to the choice of the functional form of the aggregate production function.

e.g. high income countries vis-à-vis low and medium income countries (Nehru and Dhareshwar, 1994) and in terms of regions, e.g. East Asia, Sub-Saharan Africa, Middle East and North Africa and so on (Senhadji, 2000). By estimating different production functions for different groups of countries, expectedly, studies have found that technology is indeed different across countries and hence input shares differ from one group of countries to another and from one country to another. This implies that it is quite misleading to use the input shares obtained from studies on industrial countries or even the ones obtained from cross-country analyses to depict technology in Egypt or any other country for that matter without proper verification. Consequently, if one wants to analyze the sources of growth in Egypt, the first order of business is to obtain using Egyptian data the weights of factor inputs in output; as weights obtained from cross-country studies could be quite misleading in analyzing the sources of growth and gauge productivity change over the years.

Relatively few studies have looked at individual country experiences. As for the case of Egypt, Kheir-El-Din and Morsi (2003) is the only study that has examined the growth experience in Egypt from the 1960s until the late 1990s. In this paper, Kheir-El-Din and Morsi have used a system of equations based on Kalman filter to estimate the parameters of an aggregate production function and TFP. These estimated parameters and TFP were used in a standard growth accounting technique to decompose growth into factor accumulation and productivity change. The most important results from this study are: First, from 1960 until the end of 1980s, most of the output growth could be attributed to capital accumulation. However, the decrease in investment since ERSAP led to a reduction in the contribution of capital and an escalation in the contribution of TFP. In fact, the study claims that there has been a negative relation between the contributions of capital and TFP to economic growth. Second, labor growth was found to be quite stable leaving capital growth to be the major driving force behind the fluctuations in real output. Third, this centrality of capital in output growth has decreased over the 1990 decade where the growth in TFP

claimed the number one spot as the biggest contributor to economic growth with 44% during 1990-1998 period.

Based on the above results and the diminishing returns to capital exhibited by the aggregate production function, the authors argue that the accumulation of capital is not “..sufficient to sustain efficient growth”. In addition, higher level of investment and hence capital is not “..always conducive for growth”. Furthermore, an argument was made that the slowdown in economic growth could be attributed to other than a deficiency in investment and capital accumulation as it is a possibility that the Egyptian economy could have surpassed the efficient threshold for capital labor ratio.

Following this line of thought, the study claims that the reduction in capital intensity would not have an adverse effect on economic efficiency, and growth is hampered by poor management as well as inefficient allocation of capital stock. Consequently, TFP contribution is key in the quest for high and sustainable growth for Egypt.

3. Data and Methodology

Unlike Kheir-El-Din and Morsi (2003) and other cross-country studies, a number of key variables for this study is obtained from Egyptian national sources with minimal data manipulation². One of the main contributions of this paper is the construction of a consistent series of capital stock. Cross-country studies often rely on one crude aggregated methodology to construct physical capital for all countries without paying much attention to individual country differences which indeed can affect the measure for capital stock³. Measures like the rate of depreciation which one should expect to

² Refer to data appendix for a detailed account of the sources of data.

³ By definition, cross-country studies cannot look with much detail at specific country differences. This is why individual country studies have an edge in analyzing specific county experience and draw specific policy implications.

vary from one country to another are assumed to be the same across regions and across countries. Interestingly, most of the individual country analyses, including Kheir-El-Din and Morsi (2003) readily rely on capital stock figures constructed by cross country studies without adjusting for country differences. This paper however, constructs a new consistent proxy for capital stock using available national data⁴.

It is assumed that output in Egypt is produced through the following transformation of inputs into output:

$$Y_t = A_t K_t^\beta (L_t H_t)^\alpha \quad (1)$$

where Y_t is real domestic output, A_t is a measure of total factor productivity, K_t is capital stock, L_t denotes number of employment, and H_t is a measure for human capital; hence the product of $(L_t H_t)$ represents skill-adjusted employment (Senhadji, 2000). Ideally, H_t should be constructed as a measure of education attainment á la Barro and Lee (1994); however due to the paucity of complete time series data on education attainment, this index is taken to represent the percentage of literate population⁵.

Log differentiates equation (1) with respect to time, one gets:

⁴ See data appendix for a description of the construction of the capital stock series.

⁵ The specification of equation (1) implies that illiterate labor does not contribute to output or that its contribution is not statistically significant due to linear relations with other explanatory variables. The validity of this restriction was explicitly tested by including illiterate labor to the output regression. Results show that the coefficient of illiterate labor in the estimated regression is not statistically significant implying the validity of such restriction.

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{A}_t}{A_t} + \beta \cdot \frac{\dot{K}_t}{K_t} + \alpha \left(\frac{\dot{L}_t}{L_t} + \frac{\dot{H}_t}{H_t} \right) \quad (2)$$

where a dot on a variable represents the rate of change of this variable with respect to time. Equation (2) represents a more general form of the widely used growth accounting equation which imposes CRS rendering the parameters of the production function β and α correspond to input shares⁶. However, in this study, this restriction is not imposed *a priori* and input coefficients are left free to assume any values depending on the data.

Equation (2) means that the growth in output $\left(\frac{\dot{Y}_t}{Y_t} \right)$ can be attributed to growth in physical capital $\left(\frac{\dot{K}_t}{K_t} \right)$ as well as growth in skill-adjusted labor, which is the sum of the growth in the quantity of employment $\left(\frac{\dot{L}_t}{L_t} \right)$ and the improvement in the quality of employment $\left(\frac{\dot{H}_t}{H_t} \right)$. The growth in output not explained by changes in inputs is then attributed broadly to changes in TFP $\left(\frac{\dot{A}_t}{A_t} \right)$.

Changes in TFP on the other hand, encompass many things. According to the theory, this term represents changes in productivity in general, whether improvement in technical efficiency or pure

⁶ It is interesting to note that almost all studies impose this CRS restriction even in case of estimating different production functions for different regions. One might expect that production in some countries or even regions does not exhibit CRS but imposing such restriction without proper validation can indeed bias the obtained estimates for input weights as well as TFP.

technological development. However, in this paper there is no attempt to differentiate between the two types of productivity changes⁷. In addition, being technically a residual, changes in TFP include two other components; first, omitted explanatory variables such as health and sociopolitical as well as socioeconomic factors affecting the productivity of inputs; and second, measurement errors and pure random shocks affecting productivity and production. For that, one should be extra careful in interpreting the changes in TFP and remember that they are not all due to productivity change!

The decomposition of real output to its different sources requires getting estimates for the coefficients characterizing the production function, β and α . The first step to get such estimates is to log linear equation (1) to become:

$$y_t = a_t + \beta k_t + \alpha(l_t + h_t) \quad (3)$$

where lowercase variables denote their corresponding log values.

In general, there are two ways to get the estimates for output elasticities, whether to estimate equation (3) directly in levels or estimate the equation in first differences. The main drawback of first differences is that long-run information contained in the data is lost in the process of differencing the data. Moreover, the theory tells us that the relationship between output and factor inputs is in levels not in first differences. However, a number of early studies shied away from using the data in levels fearing from spurious regressions especially if the variables are nonstationary, which usually the case. Nevertheless, a more accurate estimates of output elasticities combines both short-term and long-term variation. The reconciliation of this problem lies in the relatively new time series literature where applying OLS on cointegrated variables yield consistent estimates of the regressors (Hamilton, 1994). Using this proposition, Nehru and Dharehshwar (1994) and Senhadji (2000) have

⁷ See Han, Kalirajan and Singh (2004) for an attempt to separate between technical efficiency and technological improvement.

estimates the parameters of the production function in levels after checking for the existence of cointegrated vectors between the variables. The methodology of this study follows the one introduced by Senhadji (2000) where first, variables are tested for unit root and if the existence of unit root is verified for all variables, then the variables are tested for the existence of cointegrated vector. Finally, if the existence of cointegrated vector is established, the production function is estimated using appropriate an estimation technique.

The sample used in this study is constrained by data availability. Whereas, the estimated capital stock series goes back as early as the 1960, reliable literacy data does not start until 1973 and the most recent available is only until 2002. Consequently, the data for this exercise spans from 1973 until 2002. This is relatively short period for time series analysis; however, it is a self-contained period as the start of the period marked the gradual movement of the economy away from centrally planned toward a more market-oriented system. Prior to 1973, especially in the 1960s, the Egyptian economy was a controlled economy based on public sector initiatives and activities. In fact, one may argue that the period prior to 1973 and the period after 1973 are two distinct periods with completely different economic, cultural and sociopolitical orientation.

Estimation Results

As explained above, the first step to obtain estimates for the aggregate production function coefficients is to test for the existence of unit root in the series. According to Table 1, Augmented Dickey Fuller (ADF) test indicates that one cannot reject the null hypothesis of the existence of unit root in all the series at the 1% level.

The second step is to test for the existence of cointegrated relation(s) between the variables of the model. This study uses a VAR based cointegration test introduced by Johansen (1991, 1995). There are five alternative specifications of the test depending on the existence of intercept and trend in both the cointegrated relation(s) and in the series themselves, i.e. outside the cointegrated relation(s) in the VEC equation. One can not test explicitly these different

specifications; hence one has to have an idea about the characteristics of the data and the underlying relation. It is hypothesized that the series in levels have linear trends and the cointegrated relation(s) have both intercepts and linear trends. This specification seems reasonable given the data series and the type of the relation between the variables. Table 2(a) and Table 2(b) represent the cointegration rank test taking the 4 variables in the model (y_t, k_t, l_t, h_t) . The only difference between the two tables is that the former includes one lag in levels in the VEC specification; whereas the latter specifies two lags. As depicted in the two tables, cointegration rank tests indicate that there is at least one integrated relation between the variables of the model at the 1% level.

After verifying the existence of a long-run relation between the variables in the aggregate production function, one is ready to estimate equation (3). It is assumed that equation (3) has an autoregressive error term. To estimate this model, autoregressive OLS technique is used with White heteroskedasticity consistent covariance matrix. Table 3 shows the results of the estimation which include the estimated coefficients, standard errors of the estimated coefficients and some diagnostic statistics.

From this table, one can point to the following observations. First, according to the listed statistics, one can assert the significance of estimated equation as a whole as indicated by the calculated F-statistics as well as the significance the individual coefficients as indicated by the t-statistics. The high values of R-squared and F-statistics are quite normal given the log transformation of the variables in the regression. As for the calculated Durbin-Watson (D-W) statistics, it has a value of nearly 2 indicating the absence of serial correlation among residuals and hence the success of the autoregressive specification of the error term. Second, the estimated output elasticities of capital (β) and skill-adjusted labor (α) turned out to be approximately 0.53 and 0.41 respectively. The estimate of the output elasticity of capital in this study is quite compatible with the results of similar growth regressions in levels with human capital

component (Nehru and Dhareshwar, 1994). In fact, despite the use of different series for capital stock and different sample size (1960-1994), Senhadji (2000) came out with a close estimate of β amounting to 0.57 for Egypt⁸. On the other hand, the estimate of Kheir-El-Din and Moursi (2003) stood at approximately 0.65, a bit higher than the previous estimates. Besides the different methodology that they use, Kheir-El-Din and Moursi used a traditional Cobb-Douglas production function without a human capital component. This specification tends to raise the output elasticity of capital relative to the output elasticity of labor especially for middle and low income countries as documented in Nehru and Dhareshwar (1994).

Sources of Growth

Before analyzing the sources of economic growth, a preliminary step is to examine the growth trends of the factors of production together with output. Looking at the figures for growth (Figure 1 through 3), one can take note of the following observations: First, there are lots of similarities between the growth trend of capital and the one for output (Figure 1 and 2). Both trends achieved their climax in the second half of the 1970s, and then dropped sharply throughout the 1980s to reach an abyss in the end of the 1980s and the first two years of the 1990s decade. With ERSAP, the economy witnessed a short-lived recovery where both growth trends rising slightly; however, this brief revitalization came to an abrupt stop as a result of internal and external shocks that hit the economy starting from the second half of the 1997 throughout the 1998 combined with ill-suited fiscal and monetary policy response⁹. The similarity in

⁸ As in the majority of growth empirics' studies, Senhadji (2000) imposed CRS on the estimated production function. This is a restriction that in this study we did not wish to impose; however, imposing this restriction has risen a little bit $\hat{\beta}$ to 0.54.

⁹ These shocks are Luxor massacre in 1997, the adverse effects of East Asian crisis in 1997 and finally the drop in the oil prices in 1998. For a

both trends is confirmed by the high correlation coefficient between output growth and capital growth amounting to 0.73; however, this bond seems to weaken over time. Second, consistent with the stylized facts, the variability of physical capital is higher than the one of output as indicated by the coefficient of variation for the two series depicted in Tables 4 and 5. In addition, the most variability was achieved in the 1970s for both series coinciding with their best growth record; however, with the apparent stagnation in capital accumulation (Figure 2), resulted from lingering enfeebled investment performance, the variability of physical capital has followed a downward trend throughout the last three decades to drop even below the variability of real output during the period 1991-2002 (see Table 4 and 5)! Third, Figure 3 shows that the growth in skill-adjusted labor is relatively stable over the period of analysis averaging 4.2%.

Abstracting from the aberrant two observations in 1980 and 1981¹⁰, the growth trend of skill-adjusted labor from one side and the capital and physical capital growth trends from another side have two similar features. The first feature is the relatively upbeat trend during the 1970s with an average growth rate of approximately 5%; and the second feature is the lackluster trend starting from the end of the 1990s with a modest growth rate of less than 4% on average.

With the obtained estimates of (β, α) , as indicated in section three, one can readily gauge the contribution of capital as well as the

discussion of the fiscal and monetary effects of these shocks, see Mohieldin and Kouchouk (2003) and Kamaly (2005).

¹⁰ These two aberrant observations originated from the figures of total workers where the growth rate of employment amounted to an impressive 8% in 1980 and decreased abruptly to -8% in the following year. One possible explanation is that this 1980 figure was the result of a statistical or computational error and the negative growth rate recorded in 1981 was meant to mitigate this error and maintain the consistency of the employment figures.

contribution of augmented labor in growth as $\hat{\beta} \cdot \left(\frac{\dot{K}}{K} \right)$ and $\hat{\alpha} \cdot \left(\frac{\dot{L}}{L} + \frac{\dot{H}}{H} \right)$ respectively. Then, the growth in TFP can be calculated as a residual as follows:

$$\frac{\dot{TFP}}{TFP} = \frac{\dot{Y}}{Y} - \left(\hat{\beta} \cdot \frac{\dot{K}}{K} + \hat{\alpha} \left(\frac{\dot{L}}{L} + \frac{\dot{H}}{H} \right) \right). \quad (4)$$

Table 6 and 7 represent the contribution of each factor together with TFP in growth. The difference between the two tables is that the first one takes the contribution of each factor in each period is absolute term. For example, during the period 1973-1980, the economy was able to more than double its output (106% growth). This growth in output can be broken into growth in physical output (69.5%), growth in human capital (18.5%) and finally, growth in TFP (18.1%). Summing these different contributions produces the growth in output for the whole period (106%). As for Table 7, the growth in the economy is standardized at 100% and the different contributions are standardized as well to sum to 100% in each period. Hence, in Table 7, the contributions of factors of production and TFP are relative shares as opposed to the absolute figures in Table 6.

Examining these two tables reveal a number of interesting observations: First, the shares and the contributions of factor inputs in economic growth reveals the centrality of physical capital in the process of economic growth in Egypt. Whether computed as absolute or relative shares, physical capital has the prime stake among the three contributors to growth. This revelation is consistent with individual and country studies which show that the main contributor to growth is physical capital even in times of growth spurts as observed in East Asia (Han, Kalirajan and Singh, 2004). However, one should note that there is an apparent decline in the contribution of physical capital over the years especially in absolute terms (see Table 6). This observation is consistent with the

moribund trend of physical capital growth as indicated previously (Figure 2).

Appealing to the law of diminishing returns to inputs, Kheir-El-Din and Moursi (2003) argue that this observed deficiency in investment could be attributed to that the Egyptian economy may have surpassed the efficient threshold for capital-labor ratio. Consequently, higher level of investment and hence capital is not “..always conducive for growth”. However several arguments could be presented to counter this claim. First, the law of diminishing returns to inputs, which is in this case physical capital, is only valid when other inputs are held constant, but in reality other inputs such as labor, human capital and technology have been increasing over time. Second, it is true that the capital-labor ratio has been increasing over time; however, the continuous increase in capital-labor ratio is one of known stylized facts of economic growth observed by Kaldor (1963). Actually, one can assert that the increase in this ratio has been quite modest since the beginning of the 1990s (see Figure 5) indicating the paucity of investment. In fact, one can argue that this observed downward trend in real output growth is the direct outcome of the deficiency in capital accumulation.

Second, opposite to the trend of physical capital, skill-adjusted labor seems to gain more ground over the years to become a significant contributor to economic growth. This is observed more clearly by examining the relative share of skill-adjusted labor which went up from 17.4% during 1973-1980 period to 22.8% during 1981-1990 period and finally reaching 37.7% during 1991-2002 period (Table 7). One might presume that this trend is the result of a more efficient use of human resource and successful process of building human capital which is reflected into higher employment or an increasing pace of literacy or both. However, the truth is far from this presumption. In fact, if one observes the trend of human capital over time as depicted in Figure 3, one can notice a slight regression in the relatively stable human capital growth trend especially near the end of the 1990s. The “cloaked” reason behind the rising share of skill-adjusted labor in growth is the dismal capital accumulation

starting from the 1980s until now. This dimness in capital accumulation over the years has artificially raised the contribution and the share of labor in growth despite its relative stability and recent stagnation.

Third, the contribution and the share of TFP in growth show high level of variability over the three studied periods. In terms of both absolute and relative contribution, the 1970s period was the best and the 1980s period was the worst. Up to 18% of the 106% GDP growth recorded in the 1973-1980 period was due to TFP growth, which translates into 17% in relative terms. However, this upbeat trend in TFP reversed its direction in the 1980s period where TFP growth contributed negatively to economic growth (-12.4% in relative terms). With ERSAP, TFP growth altered its damaging trend to again add positively to economic growth where 7% of the 52% growth in GDP achieved in 1991-2002 period was due to TFP improvement.

Fourth, in terms of overall growth experience in the last three decades, the best growth performance took place in the first period (1973-1980) where output more than doubled in a period of 8 years with an impressive average growth of 13.3% per annum. Output growth slowed down in the following period (1981-1990) to record 61.3% for the overall period with an average growth of 6.1%. The decline in output growth continued in the third period where the cumulative output growth amounted to a mere 52% in 12 years with a feeble growth average of 4.3% per annum.

This result is somewhat expected given the lingering weak capital accumulation starting from the beginning of the 1980s and the mediocre human capital accumulation throughout the three studied periods. In fact, what is a bit surprising in the third period is that output growth did not experience a similar significant downward trend following the drop in the factor inputs especially in capital accumulation, the main fuel of growth, near the end of the period. One possible explanation of this observation lies in the behavior of TFP. To get more representing illustration of TFP, one can construct TFP series from the change in TFP series obtaining by equation 4

assuming that the initial value of TFP in 1973 was zero. Figure 4 depicts the trend of TFP over the three studied periods. Again similar to other factor inputs and output, the peak of TFP took place in second half of the 1970s after the *Ifitah* period. However, what it is interesting is that during the 1980s TFP experienced a continuous decline until reaching a trough in 1991. As mentioned previously, TFP contributed negatively to growth throughout the 1980s period until the onset of ERSAP in 1991. However, with the implementation of ERSAP, TFP started to climb, very modestly in the beginning until 1996, then gaining momentum afterwards.

The third analyzed period needs some further analysis given its relevance and link to the current macroeconomic stance. The period starts in 1991 which marked the poorest performance of the Egyptian economy in the last three decades and the launch of ERSAP to stabilize and reform the Egyptian economy. As a result of the tight fiscal policy and contractionary monetary policy in the first phase of ERSAP to curb inflation and to subside final demand, investment slide down even further for two consecutive years where physical capital growth recorded its lowest level in more than 30 years of 1.8% in 1993 (see Figure 2). However, this free fall in the growth in physical capital came to a stop in 1994 and signs of recovery transpired in 1995 with a growth rate in physical capital reaching approximately 6% as a result of the stabilization in the macroeconomy, the implementation of reforms in different areas of the Egyptian economy and the launch of an ambitious privatization program. For the next consecutive years, investment was relatively stable and the growth in capital stock was hovering around 5%.

With the external and internal shocks taking place in the late 1997 and in 1998 (see footnote 9) as well as the inadequate policy response and consistent with the boom-bust cycle characterizing most of the stabilization programs in developing countries (Kiguel and Liviatan, 1992; Calvo and Végh, 1994; Hamann, 1999), the growth in factor inputs, capital and labor, witnessed an apparent deterioration pushing down output growth as depicted in Figure 1. What is really alarming is that this downward trend does not seem to be the result of only those above mentioned shocks, but rather a

tendency that is gaining momentum with no sign in the horizon pointing to a reversal of this murky path. The only bright spot is related to the trend of TFP. As shown in Figure 4, after its disappointing “growth-repressing” performance in the 1980s, TFP trend has shown signs of recovery during the implementation of ERSAP from 1992 till 1996 as documented by Kheir-El-Din and Morsi (2003)¹¹. Nevertheless, the noticeable boost in the trend of TFP took place starting from 1997 and continued until 2002, the end of the analysis period. It is true that the record low trend in the traditional factor inputs, capital and labor, would possibly inflate the contribution of TFP change in GDP growth; however, there is no doubt that there has been conspicuous improvement in TFP starting from 1997 with an apparent ascendant trend as depicted in Figure 4. An interesting question now poses itself: Will this buoyant trend in TFP continue, subside or rise especially with the newly introduced array of structural reforms in key areas such as trade, taxes and investment pushed by the new cabinet appointed in 2004? Regardless of what the future will bring to answer this question, one thing is certain: with the observed and “forecasted”¹² deficiency of investment, the Egyptian economy has very little hope to achieve the type of economic growth capable of turning heads!

5. Conclusion and Policy Implications

This paper aims at analyzing the growth experience as well as the sources of growth in Egypt during three decades from 1973 till 2002. The studied period is divided into three sub-periods: the first covers the period 1973-1980, the second covers the period 1981-1990, and finally the third covers the period 1991-2002. Using data on real

¹¹ It is worthy of noting that Kheir-El-Din and Morsi (2003) did not only find that TFP trend recovered in the 1990s with the implementation of ERSAP but also TFP was the highest contributor in GDP growth with an impressive share of 44% during the period 1990-1998.

¹² IMF (2005) projections of 2005 and 2006 indicate that investment will not surpass 17% of GDP which is lower than domestic saving leading to net capital outflow, a continuation of a trend observed in 2002.

output, a newly constructed capital stock series and skill-adjusted labor figures, an aggregate production function was estimated after establishing the existence of a long-run relation relating these variables. Looking at the evolution of factor inputs and output together with the contribution of factor inputs and productivity in economic growth, one can establish the following conclusions:

First, capital stock appears to be the most important source of growth throughout the studied period. Due to the centrality of physical capital and its inherited volatility, the growth trend of real output seems to follow closely the one of physical capital. As a result any stagnation or diminution in investment has been passed to output growth trend as observed throughout the 1980s until the beginning of the 1990s and more recently at the end of the 1990s. In fact, one can argue that this observed downward trend in real output growth is the direct outcome of the deficiency in capital accumulation.

Second, there seems to be a continuous corrosion in output growth throughout the studied period. The highest level of growth was achieved in the first period with an average growth of 13.3% and the lowest level of growth was achieved in the third period with an average growth of 4.3%. The main culprit behind this alarming trend is the low level of capital accumulation due to the deficiency in investment. However, one should add that even the stable skill-adjusted labor growth trend has been generally downwards.

Third, ERSAP was implemented in a period where the Egyptian economy hit rock bottom in the beginning of the 1990s. With the successful implementation of stabilization policies and sectoral reforms, the economy showed signs of recovery where both investment and output growth picked up from all times low. However, following the boom-bust cycle associated with orthodox stabilization and reform programs and a series of internal and external shocks, the Egyptian economy slipped back to a recession around the end of the 1990s continuing until the end of the analysis period.

Fourth, the only bright spot in the third period is the path of TFP. TFP reached its best performance in the 1970s, but completely crushed in the 1980s to the extent it added negatively to growth during the second period. However, after the implementation of ERSAP, TFP has gained some momentum starting from 1997 and has been climbing since with no sign of reversing its upward path. However, despite this upward trend in TFP and its contribution to economic growth, the economy can not depend solely on improvement and gain in TFP to lead growth especially when factor inputs, especially physical capital, follow a noticeable plunge.

Lastly, from the above analysis, it is quite obvious that investment deficiency has been plaguing the economy since the mid 1980s. The trend in physical capital accumulation and more recently skill-adjusted labor have been quite alarming and needs immediate plan of action to salvage output growth trend. If government policies fail to revive investment, Egypt has very slim chance for any major economic progress.

References

- Barro, R., Lee, J., 1993. International Comparisons of Educational Attainment. *Journal of Monetary Economics* 32, 363--94.
- Calvo, G., Vegh, C., 1994. Inflation Stabilization and Nominal Anchors. *Contemporary Economic Policy* 12(2), 35--45.
- Hall, R., Jones, C., 1999. Why do Some Countries Produce So Much More Output Per Worker Than Others? *Journal of Econometrics* 53, 87--121.
- Hamann, A.J., 1999. Exchange Rate-Based Stabilization: A Critical Look at the Stylized Facts. IMF Working Paper WP/9/132.
- Hamilton, J.D., 1994. *Time Series Analysis*. Princeton: Princeton University Press.

- Kamaly,A. *Economic Growth Before and After Reform: The Case of Egypt*
- Han,G., Kalirajan, K., Singh N., 2004. Productivity, Efficiency, and Economic Growth: East Asia and the Rest of the World. *Journal of Developing Areas* 37(2), 99--118.
- Kaldor, N., 1963. Capital Accumulation and Economic Growth, in: Lutz, F. A., Hague, D.C. (Eds.), *Proceedings of a Conference Held by the International Economics Association*. London, Macmillan.
- Kheir El Din, H., Moursi, T. A., 2003. Sources of Economic Growth and Technical Progress in Egypt: An Aggregate Perspective. *Economic Research Forum Global Research Project*. Online.
- www.gdnet.org/pdf2/gdn_library/global_research_projects/explainin_g_growth/Egypt_growth_final.pdf
- Kiguel, M., Liviatan, N., 1992. The Business Cycle Associated with Exchange Rate-Based Stabilizations. *World Bank Economic Review* 6(1), 279--305.
- Kamaly, A., 2005. On the Effectiveness of Monetary Policy in Egypt. *The Middle East Business and Economic Review* 17(1), 1--19.
- Johansen, S., 1991. Statistical Analysis of Cointegration Vectors, in: Engle, R. F., Granger, C.W. (Eds.), *Long-Run Economic Relationships: Readings in Cointegration*, Advanced Texts in Econometrics. Oxford University Press, pp 131--52
- Johansen, S., 1995. Identifying Restrictions of Linear Equations with Applications to Simultaneous Equations and Integration. *Journal of Econometrics* 69(1), 111-32
- Mohieldin, M., Kouchouk, A., 2003. On Exchange Rate Policy: The Case of Egypt 1970-2001,mimeo.

Nehru, V., Dhareshwar, A., 1994. New Estimates of Total Factor Productivity Growth for Developing and Industrial Countries. World Bank Policy Research Working Paper No.1313.

Senhadji, A., 2000. Sources of Economic Growth: An Extensive Growth Accounting Exercise. IMF Staff Papers, 7 (1).

Solow, R., 1957. Technical Change and the Aggregate Production Function. Review of Economics and Statistics 39, 312--320.

Young, A., 1995. The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience. Quarterly Journal of Economics, 110(3), 641-80.

Data Appendix

Base year is taken to be 1995.

Source of data:

Number of workers: Ministry of Planning, Government of Egypt (GOE)

Literacy rate: World Development Indicators (CD-Rom), 2004

GDP: International Financial Statistics (IFS) database

Capital Stock: Please refer to “Estimating the Egyptian Capital Stock” below

Estimating the Egyptian Capital Stock

The following data series were used in this process of producing an estimate for the Egyptian capital stock:

NAME OF THE SERIES	SOURCE	NOTES
Depreciation allowance	National Final accounts: Ministry of Planning GOE	Not a complete series with lots of missing observations
Nominal investment	National Final accounts: Ministry of Planning GOE	Not a complete series with lots of missing observations
Nominal investment	IFS	
CPI	IFS	
GDP deflator	IFS	Series starts from 1982

The following steps were taken to estimate the capital stock series:

1. Interpolate the gaps in the nominal investment (I_t) from the Ministry of Planning using the nominal investment series obtained from the IFS.
2. Interpolate the gaps in the GDP deflator using the CPI series.
3. Use the GDP deflator to obtain real investment.

4. Obtain several estimates of capital stock in the years where depreciation allowance is available using the following relation:
 $D_t = \delta \cdot K_t$ where D_t : depreciation allowance, δ : depreciation rate and K_t : physical capital stock. Assuming values for δ and knowing the value of the depreciation allowance, one can deduce the capital stock associated with each assumed value of δ . The following values for δ were assumed: 5%, 6%, 7%, 8%, and 9%.

5. Knowing $K_t(\delta)^{13}$, I_t ($t=1960.....2002$) and δ , K_t was estimated for the whole sample by updating forward and backward as follows:

Assume that K_t is known at t, then one can get the values of

capital stock before t using: $K_{t-1} = \frac{K_t - I_t}{1 - \delta}$; similarly, one can

obtain the values of capital stock after t using:
 $K_{t+1} = I_{t+1} + (1 - \delta)K_t$. The result of this step is constructing five different capital stock series corresponding to the assumed values of δ as indicated in point 2.

6. Obtain five series of depreciation allowance based on the estimated five series of $K_t(\delta)$ obtained above in point 3.

7. Get δ^* which solve: $Arg.Min_{\delta} \left(\sum_{i=1}^N (D_i - D_i(\delta))^2 \right)$ for

$\delta = 5, 6, 7, 8, 9$ and N: the number of observations where actual depreciation allowance is available.

8. It was found that $\delta^* = 7\%$; in addition, the above function appears to have a convex structure with one local minimum at 7%.

¹³ K_t is known for only time t where depreciation allowance is known as explained in the second point.

Tables:

Table 1: ADF Test

VARIABLES	y_t	k_t	l_t	h_t	$l_t + h_t$
ADF Test Statistic	-1.83	-1.92	-2.65	1.57	-1.09

1% Critical value: -4.28

5% Critical value:-3.56

10% Critical value: -3.21

Table 2(a): Cointegration Rank Test (One lag)

Hypothesized	Trace Eigenvalue	Percent	1 Percent Statistic	No. of CE(s)	Critical Value
<i>None **</i>	0.93	120.88	62.99		70.05
<i>At most 1</i>	0.52	41.38	42.44		48.45
<i>At most 2</i>	0.36	19.54	25.32		30.45
<i>At most 3</i>	0.19	6.27	12.25		16.26

*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Table 2(b): Cointegration Rank Test (Two lags)

Hypothesized	Trace	5
Percent	1 Percent	
No. of CE(s)	Eigenvalue	Statistic
Critical Value		Critical Value
<i>None **</i>	0.71	95.88
62.99	70.05	
<i>At most 1 **</i>	0.62	58.44
42.44	48.45	
<i>At most 2 *</i>	0.45	29.63
25.32	30.45	

<i>At most 3</i>	<i>0.32</i>	<i>11.72</i>
<i>12.25</i>	<i>16.26</i>	

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Trace test indicates 3 cointegrating equation(s) at the 5% level

Trace test indicates 2 cointegrating equation(s) at the 1% level

Table 3: Estimate of the Aggregate Production Function

ESTIMATED COEFFICIENT	INTERCEPT	$\hat{\beta}$	$\hat{\alpha}$
Standard errors in parenthesis	-0.132 (1.143)	0.528 (0.099) **	0.413 (0.145) **
Adj. R-squared	0.99	D-W Statistics	1.86
Statistics	3362.97 **		F-

*(**) denotes significance at the 5% (1%) level

Table 4: Real Output Statistics (Figures in billion LE)

Period	Mean	Standard Deviation	Coefficient of Variation
Overall	152.4	75.6	0.50
1973-1980	59.2	22.2	0.37
1981-1990	137.0	23.9	0.17
1991- 2002	227.3	40.7	0.18

Table 5: Capital Statistics (Figures in billion LE)

Period	Mean	Standard Deviation	Coefficient of Variation
Overall	270.9	161.5	0.60
1973-1980	67.1	29.9	0.45
1981-1990	238.3	65.6	0.28
1991- 2002	433.9	66.9	0.15

Table 6: Contributions of Factor Inputs to Output Growth (Figures in percentage)

Period	Physical Capital	Human Capital	TFP	Total Output Growth
1973-1980	69.5	18.5	18.1	106.1
1981-1990	54.9	14	-7.6	61.3
1991- 2002	25.4	19.6	7	52

Table 7: Shares of Factor Inputs in Output Growth (Figures in percentage)

Period	Physical Capital	Human Capital	TFP
1973-1980	65.5	17.4	17
1981-1990	89.6	22.8	-12.4
1991- 2002	48.9	37.7	13.5

Figures:

Figure 1: Output Growth

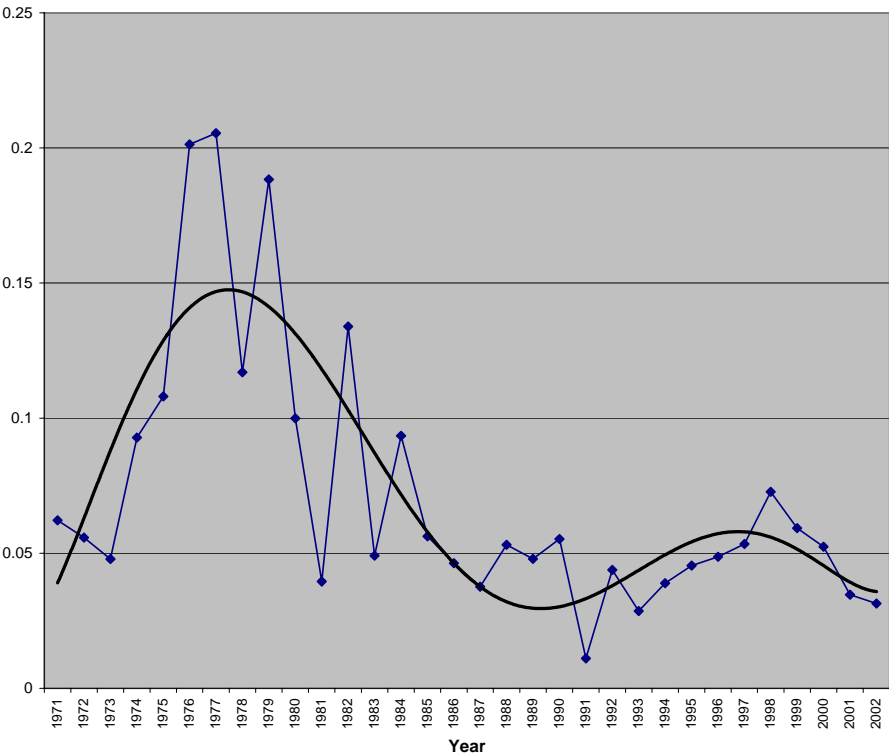


Figure 2: Capital Growth

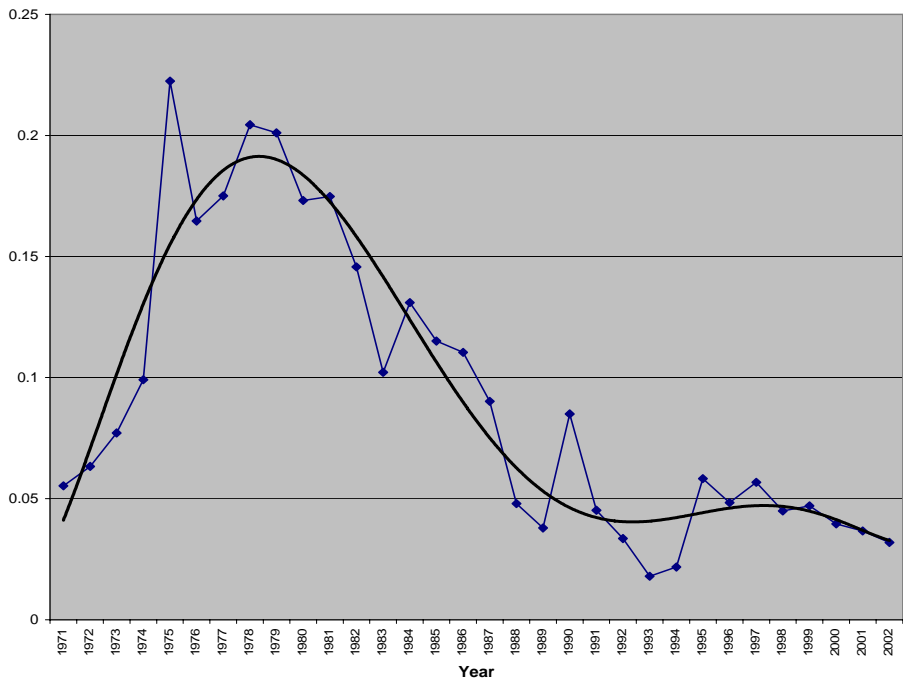


Figure 3: Human Capital Growth

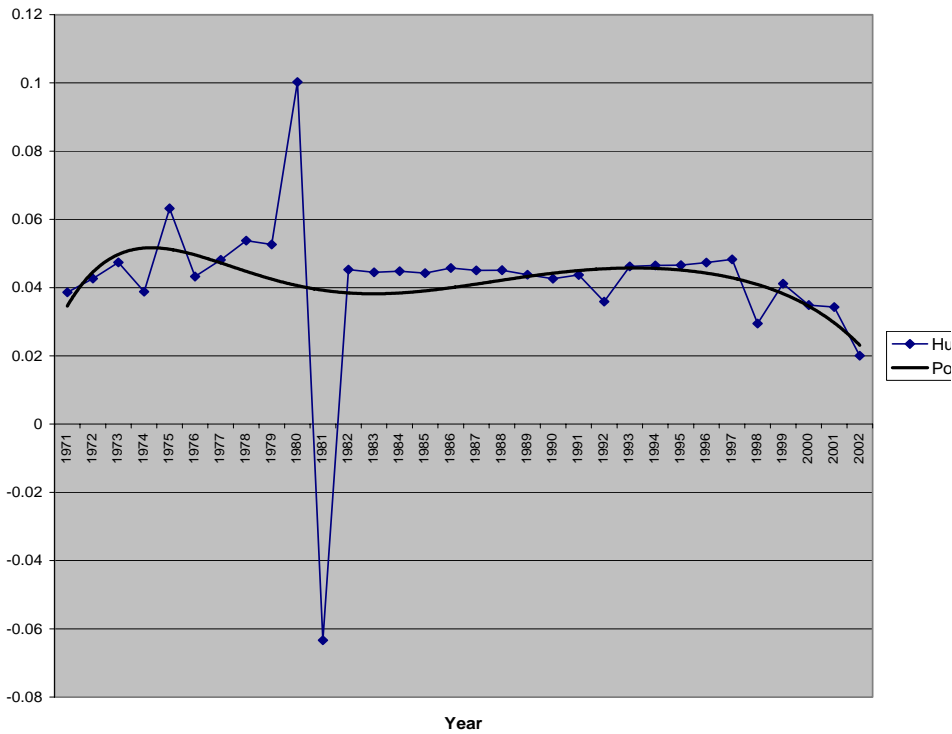


Figure 4: TFP Trend

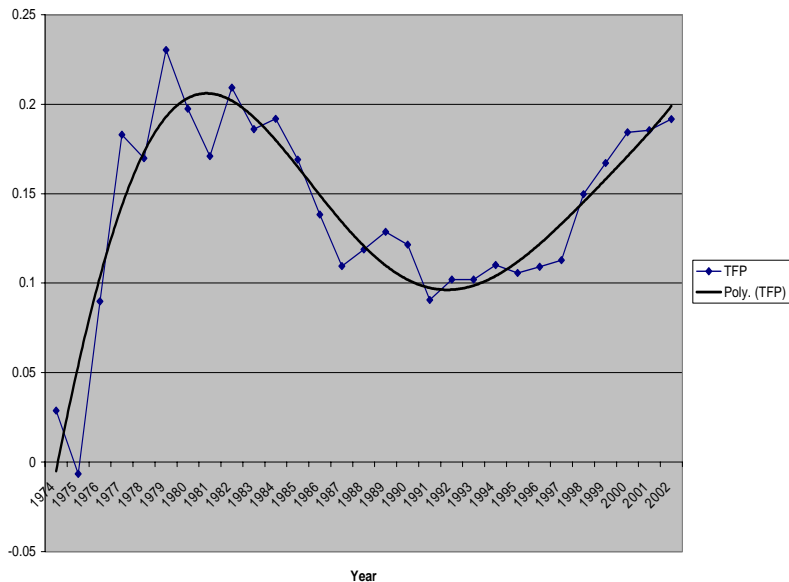


Figure 5: Capital-Labor ratio Trend

